



VOL. 2, NO. 3  
MARCH 2007

# Economic Letter

A stylized world map graphic in shades of teal and blue, with a brown banner overlaid on the right side containing the text "Insights from the FEDERAL RESERVE BANK OF DALLAS".

*Insights from the*  
FEDERAL RESERVE BANK OF DALLAS

## Obstacles to Measuring Global Output Gaps

by Mark A. Wynne and Genevieve R. Solomon

*In the past, the focus was largely on domestic slack. Now, some analysts contend the ongoing process of globalization requires policymakers to look at global slack as well.*

The Federal Open Market Committee routinely refers to resource utilization in its assessment of U.S. inflation risks. In the press release following its January meeting, for example, the FOMC noted that although core inflation had moderated, “the high level of resource utilization has the potential to sustain inflation pressures.”

Other central banks frequently explain their monetary policy decisions in similar terms. In its February 2007 Inflation Report, for example, the Bank of England noted that “in the short to medium term, inflation is influenced by the balance between the demand for private sector output and the supply available to meet that demand. That balance reflects, in turn, the degree of spare capacity within businesses and conditions in the labor market.”



*The production-function approach arrives at potential output by determining the economy's available stocks of labor and capital, then combining these endowments with an estimate of multifactor productivity.*

These statements make it clear that monetary policymakers pay close attention to levels of resource use. In the past, the focus was largely on domestic slack. Now, some analysts contend the ongoing process of globalization requires policymakers to look at global slack as well.

A growing body of evidence suggests inflation in many countries is less closely related than it once was to domestic slack. There is also evidence—and this is more controversial—that domestic inflation may be tied to global slack.

Calculating global production capacity and slack presents challenges. This is true even when looking at advanced industrial countries that compile the data required to accomplish the task. But what happens when nations don't track the needed numbers? What kind of problem does that pose for policymakers, especially when these nations are responsible for a growing share of the world's output?

### **Gauging Potential Output**

The output gap—a key measure of resource utilization—is the difference between the amount produced in a given period and the economy's potential level of output.<sup>1</sup> Positive gaps—that is, output levels in excess of potential—are usually associated with increased price pressures. Negative gaps—output levels below potential—are usually associated with decreased pressures.

Governments routinely report actual production quarterly. To compute output gaps, however, we also need measures of potential output. Economists have taken two main approaches to developing them.

The first relies on statistical techniques to estimate the trend growth rate. The simplest estimate is a straight line fitted to historical data. A drawback to this approach is the assumption that output will grow at a constant rate—an assumption that's not always warranted. The U.S. economy grew faster in the two decades before

1973 than it did in the two after, and it expanded more rapidly over the past decade than it did between the early 1970s and early 1990s.

It's possible to employ more sophisticated approaches that allow for varying trend rates of growth. While relatively easy to implement, these techniques are subject to a drawback usually referred to as the end-point problem. Estimates of potential output derived from such measures tend to be least reliable at the beginning and end of sample periods. Errors in calculating output gaps of, say, 40 years ago may be an issue for students of economic history. But mismeasuring today's potential output can have serious implications if the estimates are used in making policy decisions.

The main alternative to estimating trend output is the production-function approach. It arrives at potential output by determining the economy's available stocks of labor and capital, then combining these endowments with an estimate of multifactor productivity.

Start with labor. The total amount of labor available for market production is determined by the size of the working-age population, the labor force participation rate, the employment rate and the number of hours logged by the average worker.

The size of the working-age population, usually defined as those aged 15–64 or 25–64, changes slowly and—more important—doesn't vary with the business cycle. The participation rate, unemployment rate and average hours worked all tend to fluctuate with economic activity. They increase when the economy is expanding and decline when it's contracting.

To measure potential labor input, we need to calculate the trend levels of these variables. When we do this for the U.S., we find that the fundamentals determining how much labor is available have varied over the past half century or so.<sup>2</sup>

The labor force participation rate—the fraction of the working-age



population that is either employed or actively looking for work—fluctuated around 59 percent through the 1950s and mid-1960s. The rate climbed steadily during the late 1960s and through the 1970s and 1980s as more women entered the labor force. It leveled off at around 67 percent during the 1990s and 2000s when the influx of women slowed (*Chart 1A*).

The unemployment rate exhibits wide swings, which can be smoothed with an estimate of the trend rate (*Chart 1B*). A more useful measure is the non-accelerating inflation rate of unemployment (NAIRU), which differs from the simple trend in that it incorporates information about the relationship between inflation and unemployment.

The NAIRU, as calculated by the Organization for Economic Cooperation and Development, rose in the 1970s, possibly due to a productivity slowdown. It then ebbed in the 1980s and 1990s. The decline at the end of the period may be related to an acceleration in productivity.

The third component of the labor input is average hours worked (*Chart 1C*). From the mid-1960s through early 1990s, average hours steadily declined. They leveled off a bit above 34 hours a week in the 1990s, then dropped around the turn of the century. Since then, the norm seems to be a tad below 34 hours.

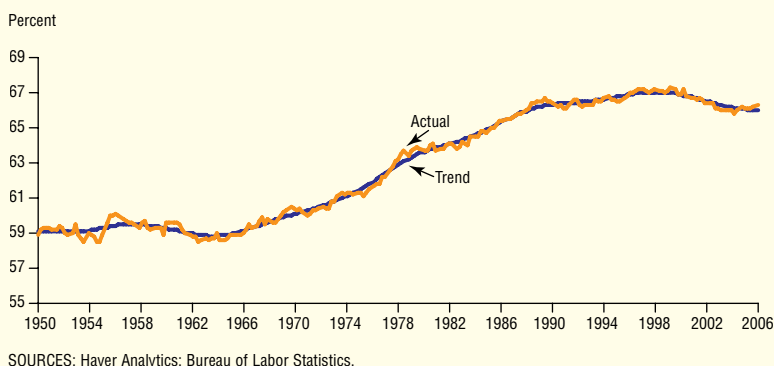
The capital stock is the second element of the economy's productive capacity. The intensity of capital stock use tends to vary over the business cycle. Companies add shifts when the economy is expanding and idle plants and equipment when it's contracting.

Measures of capacity utilization try to capture these cyclical variations. To gauge the economy's potential output, however, we can use estimates of the capital available at a given time. Statisticians determine the capital stock by tracking nations' annual investment in plants, equipment and buildings, then adjusting for depreciation. The

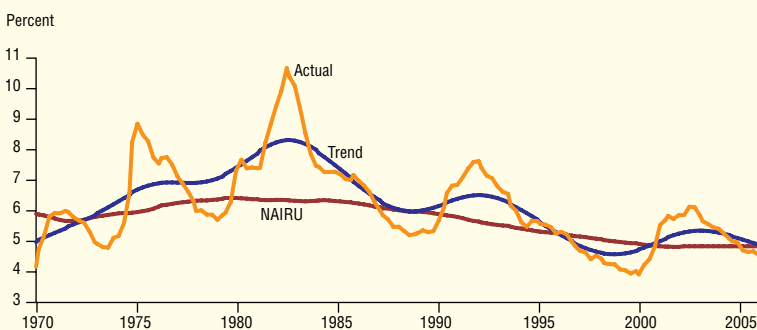
Chart 1

## U.S. Labor Force Changes over Time

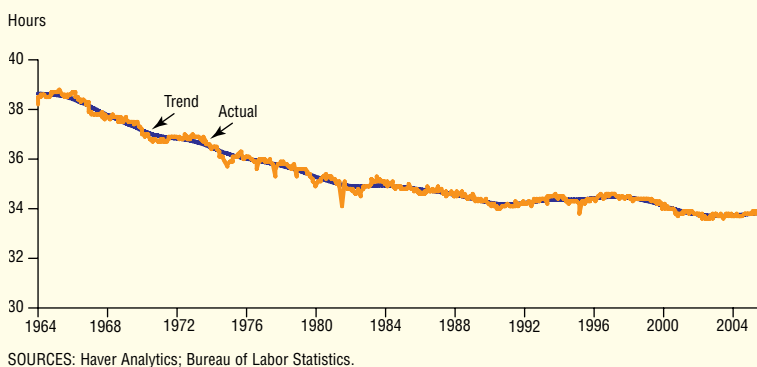
### A. Participation



### B. Unemployment



### C. Average Weekly Hours Worked





*The big, emerging market economies lack some of the most fundamental ingredients needed to construct a measure of resource utilization.*

U.S. capital stock has grown steadily over long periods.

Once we have estimates of available labor and capital, the remaining part of the puzzle is productivity. The key determinant of rising living standards is the increased output obtainable from available stocks of labor and capital.

U.S. multifactor productivity has been rising steadily (*Chart 2*). Annual average growth has doubled from 0.7 percent in 1988–94 to 1.4 percent since 1995.<sup>3</sup>

The production-function approach yields reasonable potential output estimates for countries with timely, accurate measures of their labor and capital stocks. Analysts make assumptions about the nature of technology to combine labor, capital and productivity into a measure of potential output.

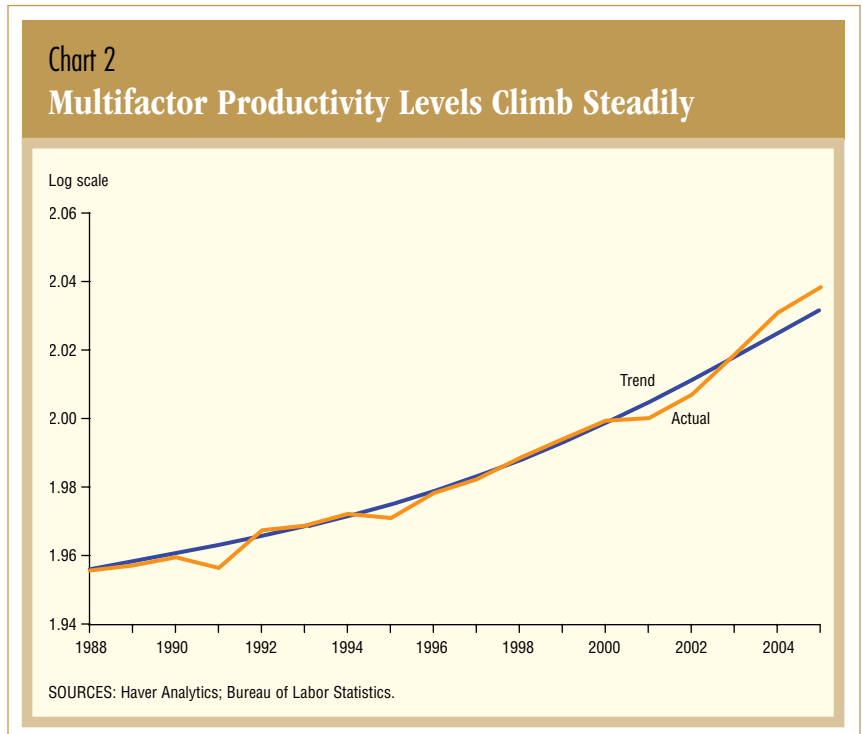
The Federal Reserve, Congressional Budget Office, OECD and many other organizations use this approach, with variations, to estimate potential GDP and the output gap. We concentrate

on the OECD's estimates because they're available for a large number of countries and based on a common methodology.<sup>4</sup>

The OECD publishes output gap estimates and forecasts for most of its member countries, usually quarterly. Output gaps for the U.S., G-7 nations (U.S., Japan, Germany, U.K., France, Italy and Canada) and OECD as a whole tend to move together (*Chart 3*). When output is below potential in the U.S., it's usually below potential in the G-7 and the rest of the OECD as well.

These measures move in tandem partly because the U.S. is included in all three. But even a more detailed look at individual countries would show significant synchronization.

Many policymakers put considerable emphasis on output gaps in their deliberations. We can see why by looking at gap estimates for the U.S., G-7 and OECD from 1970 to 2005 plotted against the change in U.S. inflation over the subsequent year (*Chart 4*). Inflation is measured





on a quarter-over-quarter basis as the annualized change in the Personal Consumption Expenditures deflator, excluding food and energy.

Traditional Phillips curve reasoning would lead one to expect a positive correlation between the two sets of data—and this is indeed the case.

### Going Global?

Advanced industrial economies have the data needed for computing output gaps. These nations, however, account for a shrinking share of global output. In 1975, the OECD countries generated 64 percent of global output, measured on a purchasing power parity basis.<sup>5</sup> By 2005, this number had fallen to 53 percent.

Taking share away were the so-called BRICs—Brazil, Russia, India and China—big, emerging market economies that lack some of the most fundamental ingredients needed to construct a measure of resource utilization.

Basic to measuring potential output is, of course, actual production, and each of the BRICs produces quarterly estimates of real GDP (*Table 1*). However, the accuracy of these estimates is probably not on a par with GDP numbers for the advanced industrial countries.

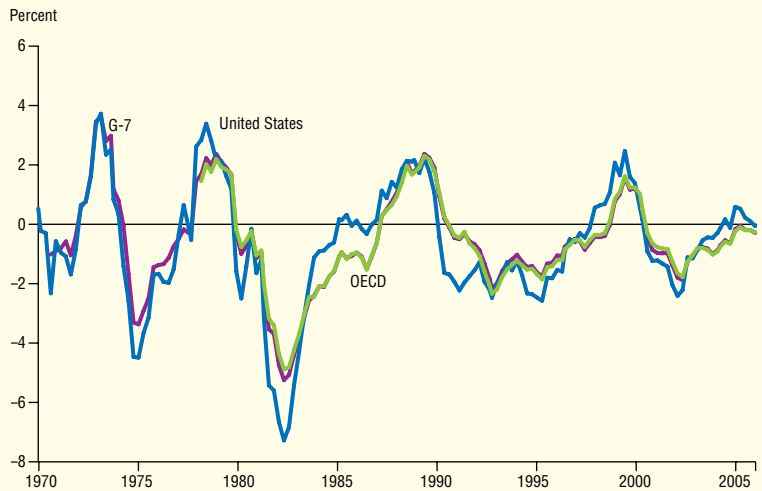
Almost all governments conduct a regular census, so annual data on total population are usually available. Likewise, most nations report the number of people employed and unemployed, which together make up the labor force.

However, China's unemployment rate only covers urban areas, making it an inadequate measure of total labor market slack. It's generally believed there are large numbers of underemployed—if not unemployed—workers in rural China.

As for hours worked, only Brazil reports an estimate, and it covers only the manufacturing sector.

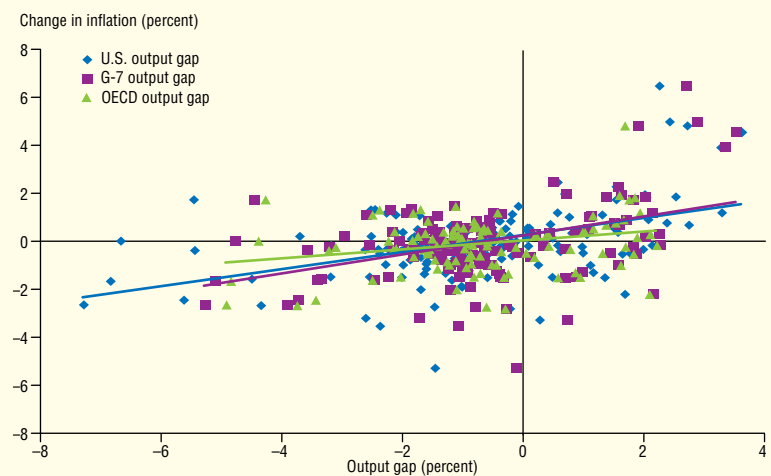
The next ingredient is capital. As any visitor to China knows, the country is in the midst of a construction boom. Yet, there are no official

**Chart 3**  
**Output Gaps Move in Sync**



SOURCE: *OECD Economic Outlook*.

**Chart 4**  
**U.S. Inflation Correlates with Output Gaps**



SOURCES: *OECD Economic Outlook*; Bureau of Economic Analysis.





Table 1

## What the BRICs Measure

	Share of global GDP (percent)	GDP	Capital input	Labor input			
				Population	Participation rate	Unemployment rate	Average hours worked
China	13.5	Yes	No	Yes	Yes	Urban areas only	No
India	6.0	Yes	Quality questionable	Yes	Yes	Yes	No
Brazil	2.7	Yes	No	Yes	Yes	Yes	Manufacturing only
Russia	2.5	Yes	Quality questionable	Yes	Yes	Yes	No

SOURCES: Haver Analytics; Bloomberg; national statistical web sites.

*Significant hurdles must be cleared before the traditional production-function approach to measuring output gaps can be extended to emerging market economies.*

estimates of China's capital stock. Attempts have been made to produce unofficial estimates of China's capital stock—the seminal contribution being made by Gregory C. Chow in 1993—but they're sometimes based on heroic assumptions.<sup>6</sup>

Nor does Brazil report official estimates of its capital stock, although unofficial estimates have been made.<sup>7</sup> There are official estimates for Russia, but most analysts consider the quality poor.<sup>8</sup> India also produces official estimates, but they're based on spotty information about how long capital is used before being discarded, and they're probably not on a par with similar data for advanced countries.<sup>9</sup>

Some may find the absence or poor quality of official capital stock numbers surprising, given that all four countries report investment, a key input for such an estimate.

In economies undergoing rapid structural change, however, the standard assumptions used to total annual investment flows into an estimate of the capital stock—such as stable or constant depreciation rates—may be untenable. After all, the essence of economic reform is the wholesale scrapping of outdated

plants and equipment that are still usable but no longer economically productive and their replacement by newer, more efficient structures and machines.

For countries like China and Russia, it's difficult to assign an accurate value to plant and equipment in current or former state-owned sectors. For countries like Brazil and India, with large informal sectors, much investment may go uncounted.

Significant hurdles must be cleared before the traditional production-function approach to measuring output gaps can be extended to emerging market economies. These hurdles have an interesting parallel in the U.S. We have abundant statistics on the agriculture and manufacturing sectors, but scant information on the increasingly important, but difficult to measure, service sector. On the international level, there is abundant and timely information on highly developed economies, but relatively few hard statistics on the increasingly important emerging market economies.

### Reliability an Issue

Even if we had data to construct output gap measures for the BRICs,



the resulting estimates would probably be subject to considerable uncertainty.

OECD nations can afford to devote far more resources to collecting economic statistics than the emerging economies. But comparing the OECD's most recent output gaps with estimates of various vintages shows that revisions—often large ones—are common (*Chart 5*).<sup>10</sup> Today's data show OECD output was about 1 percent below potential in 1997. In June 2003, however, output was estimated as being at potential in 1997, with no gap at all.

A second reason for questioning the usefulness of constructing global output gap measures is the weakening of the correlation between existing measures and U.S. inflation. We looked at two different break points, one corresponding to Eastern Europe and the Soviet Union's opening in 1990, the other to the onset of the IT revolution in 1995. Regardless of where we split the sample, a striking decline occurs in the correlation between the measured output gaps and subsequent inflation (*Table 2*).

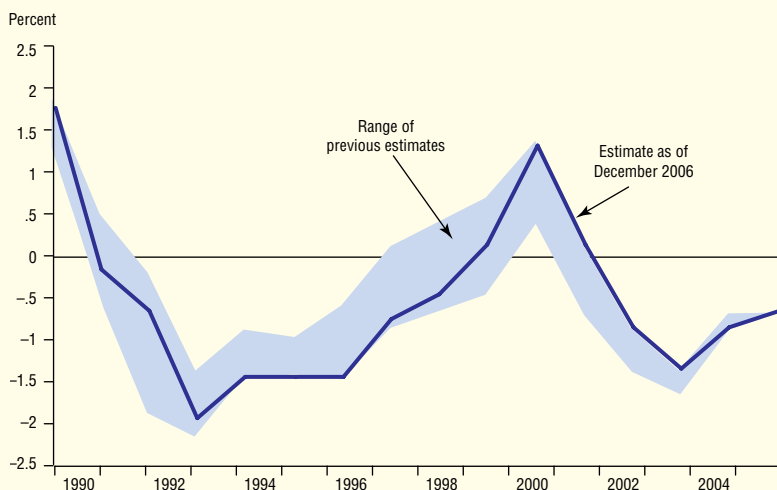
It's well known that for both the U.S. and the other OECD countries, the relationship between domestic slack and inflation has weakened, although the reasons for this aren't well understood. Globalization is one possible explanation. Better monetary policy is another.

If central bankers are to use a broader, global measure of the output gap in their deliberations, data deficiencies will present a major challenge. And even if the data obstacle is overcome, interpreting the global output gap in real time will be as much art as science.

*Wynne is a senior economist and vice president and Solomon an economic analyst in the Research Department of the Federal Reserve Bank of Dallas.*

**Chart 5**

**Revisions Plague Estimates of OECD Output Gap**



SOURCE: OECD Economic Outlook.

**Table 2**

**Correlation Between Output Gaps and Subsequent U.S. Inflation**

	Correlation with U.S. gap	Correlation with G-7 gap	Correlation with OECD gap
1970–2005	.47	.42	.23
1970–1989	.53	.51	.36
1990–2005	.07	-.15	-.13
1970–1994	.50	.45	.26
1995–2005	.13	.05	.06

NOTES: The G-7 correlation for the 1970–89 period is for 1971–89; the OECD correlation is for 1979–89. Data are quarterly.

SOURCES: OECD Economic Outlook; Bureau of Economic Analysis.

## Notes

<sup>1</sup> This is a very traditional definition. The modern literature on the theory of monetary policy (as exemplified by Michael Woodford's *Interest and Prices*) defines output gaps somewhat differently, as the deviation of actual output from what it would be in a frictionless world.

<sup>2</sup> In each case, the trend value is estimated using the Hodrick–Prescott filter with smoothing parameter equal to 1600.

<sup>3</sup> A mathematical formula shows how these elements are combined to arrive at an estimate of potential GDP:

$$\overline{GDP} = (\overline{A} \times POP \times \overline{LFPR} \times (1 - NAIRU) \times \overline{HRS})^\alpha (K)^{1-\alpha},$$

where  $\overline{GDP}$  denotes potential GDP,  $\overline{A}$  is trend multifactor productivity,  $POP$  the working-age population (usually those aged 15–64),  $\overline{LFPR}$  the trend rate of labor force participation,  $NAIRU$  the non-accelerating inflation rate of unemployment,  $\overline{HRS}$  the trend level of annual hours worked per employee,  $K$  the capital stock and  $\alpha$  the average share of labor income in national income. The output gap is defined as  $Gap = GDP - \overline{GDP}$ .

<sup>4</sup> Details of the OECD's approach are given in "New OECD Methods for Supply-Side and Medium-Term Assessments: A Capital Services Approach," by Pierre-Olivier Beffy, Patrice Ollivaud, Pete Richardson and Franck Sédillot, OECD Economics Department Working Paper no. 482, July 2006.

<sup>5</sup> Czech Republic, Slovak Republic and Poland are excluded because GDP data adjusted for purchasing power parity do not go back to 1975 for these countries.

<sup>6</sup> "Capital Formation and Economic Growth in China," by Gregory C. Chow, *Quarterly Journal of Economics*, vol. 108, August 1993, pp. 809–42.

<sup>7</sup> See, for example, "Capital Accumulation in Latin America: A Six Country Comparison for 1950–89," by André A. Hofman, *Review of Income and Wealth*, vol. 38, December 1992, pp. 365–401, and "Estimativa do estoque de riqueza tangível no Brasil, 1950–1998," by Adalmir A. Marquetti, *Nova Economia*, vol. 10, December 2000, pp. 11–37.

<sup>8</sup> See, for example, "National Wealth Estimation in the USSR and the Russian Federation," by Leonid I. Nesterov, *Europe–Asia Studies*, vol. 49, December 1997, pp. 1471–84, or "Measuring the Capital Stock in Russia: An Unobserved Component Model," by Stephen G. Hall and Olivier Basdevant, *Economics of Planning*, vol. 35, issue 4, 2002, pp. 365–70.

<sup>9</sup> See "National Accounts Statistics Sources and Methods, 1989," from the Indian Ministry of Statistics and Programme Implementation, Central Statistical Organization, [http://mospi.nic.in/nas\\_snm.htm](http://mospi.nic.in/nas_snm.htm).

<sup>10</sup> The December 2006 issue of *Economic Letter* addresses how revisions to economic statistics can complicate the job of economic policymakers. Available at [www.dallasfed.org/research/ecllett/2006/el0612.html](http://www.dallasfed.org/research/ecllett/2006/el0612.html).

**Economic Letter** is published monthly by the Federal Reserve Bank of Dallas. The views expressed are those of the authors and should not be attributed to the Federal Reserve Bank of Dallas or the Federal Reserve System.

Articles may be reprinted on the condition that the source is credited and a copy is provided to the Research Department of the Federal Reserve Bank of Dallas.

*Economic Letter* is available free of charge by writing the Public Affairs Department, Federal Reserve Bank of Dallas, P.O. Box 655906, Dallas, TX 75265-5906; by fax at 214-922-5268; or by telephone at 214-922-5254. This publication is available on the Dallas Fed web site, [www.dallasfed.org](http://www.dallasfed.org).



**Richard W. Fisher**  
President and Chief Executive Officer

**Helen E. Holcomb**  
First Vice President and Chief Operating Officer

**Harvey Rosenblum**  
Executive Vice President and Director of Research

**W. Michael Cox**  
Senior Vice President and Chief Economist

**Robert D. Hankins**  
Senior Vice President, Banking Supervision

Executive Editor

**W. Michael Cox**

Editor

**Richard Alm**

Associate Editor

**Monica Reeves**

Graphic Designer

**Ellah Piña**



FEDERAL RESERVE BANK OF DALLAS  
2200 N. PEARL ST.  
DALLAS, TX 75201